

# **Waterway and Wetland Handbook**

## **CHAPTER 85**

### **CULVERT WATERWAY CROSSINGS**

#### **GUIDANCE PURPOSE AND DISCLAIMER**

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#### **PURPOSE**

A fundamental principle in Wisconsin is that navigable waters are common highways and should remain forever free for public use. Various rules and statutes now regulate the construction of culverts in navigable waters. The regulations allow the Department to control the degree of obstruction to navigation, to minimize their potential obstruction to flows, to minimize erosion, sedimentation and washout potential, and to control other adverse environmental effects.

#### **MECHANISM**

Culvert waterway crossings are reviewed or approved in accordance with several sections of the statutes.

Section 30.12, Wis. Stats., requires a structure permit for private and municipal non-highway culvert waterway crossings. The structure permit authorizes placement of a culvert(s) and fill necessary to construct a roadway.

Section 30.12(4), Wis. Stats., exempts highway and bridge activities conducted under the direction and supervision of the Department of Transportation from prohibitions or permit and approval requirements of various statutes. Such activities must, however, be performed in accordance with inter-Departmental liaison procedures or the exemption does not apply (see the copy of the Cooperative Agreement between DOT and DNR date 10-25-76 attached to Chapter 80 of the Handbook).

Sections 30.10 and 30.123, Wis. Stats., exempt municipal highway bridges, arches or culverts from permits or approvals under ss. 30.10, 30.12, or 31.23. However, all municipal highway bridges, arches or culverts shall be constructed according to the standards of Trans 207, Wis. Adm. Code, or the municipality is subject to enforcement action. The definition of 'municipal highway bridge' contained in Chapter NR 320.03(6) should be applied. Conceptual plans for municipal highway projects are to be submitted to the Department for evaluation and recommendations regarding clearance, flood flow capacity and erosion control. Permits or approvals under ss. 30.11, 30.195, or 30.20 would still be required if appropriate. Minor waterway modification needed to place or construct the bridge arch or culvert do not require permits. Temporary roads, access roads or cofferdams

needed for completion of the project would not require a separate permit since they are considered to be necessary to complete the highway construction.

Section 30.122, Wis. Stats., provides that structures constructed prior to December 9, 1977, which did not require a permit at the time are presumed to be in conformity with the law. This statute applies to culvert waterway crossings since the Department and its predecessor agencies for many years considered these crossings to be bridges which required no permit authority unless they crossed navigable waters at least 35 feet wide, in which case a bridge permit was required. This practice continued until a 1974 Bureau of Legal Services opinion advised that a structure permit pursuant to s. 30.12, Wis. Stats. was the appropriate mechanism to approve culvert waterway crossings. That opinion also indicated that a bridge over a stream required plan approval in order to comply with s. 30.10, Wis. Stats. This statute (s. 30.122) does not legalize older culvert waterway crossings. If such a structure should prove to be an obstruction to navigation, appropriate enforcement action can be initiated.

## HISTORY

See Chapter 70 of the handbook which is the general chapter on structures. See Chapter 80 on bridges for additional information.

## CULVERT WATERWAY CROSSING STANDARDS

### *Statutory Standards*

Section 30.12, Wis. Stats., contains the following standards:

1. "The Department may ... grant to any riparian owner a permit to build or maintain for the owner's use a structure otherwise prohibited by statute..."

Although this language seems to be only introductory, it does provide us with two elements of Legislative direction. The permit applicant must be a riparian owner (or leasee). Presumably, the structure applied for would have to be within his zone of riparian influence or control. Thus, if an owner who owned one half of the stream wanted to construct a culvert waterway crossing he would need to have the owner of the other half of the stream join him in applying for a structure permit. Secondly, a structure may be placed in navigable water purely for private as opposed to public purposes.

2. A permit may be granted "if the structure does not materially obstruct navigation..."

Several factors must be considered in order to evaluate a culvert waterway crossing. If the waterway has a history of use for navigation or is likely to be used for navigation, evaluations should be considered:

- a. **Type of Watercraft:** On smaller streams canoes may be the only, or major, type of watercraft used. Canoes generally require less clearance than other watercraft. A small stream may be used by hunters in flat bottom boats which require more horizontal clearance than a canoe. In larger streams and lakes rafts, pontoons or large pleasure boats may have developed a pattern of use.
- b. **Amount of Use:** For a stream or portion of a lake which has very little or no navigation, the alternative of providing portage may very well satisfy the requirement of not materially

obstructing navigation. Where a waterway is used regularly for navigation, a material obstruction to navigation may exist, unless sufficient navigational clearance is provided for the normally used watercraft even though (in the case of a lake) an alternative route is available.

- c. Seasonal Navigation: Many streams are used for canoeing or rafting only during periods of high water. While a culvert crossing may seem to be sufficient for navigation at normal water levels, it could be a material obstruction to navigation as well as a safety hazard during high water. For such a case, a bridge, ford or minimum fill culvert installation may be the only acceptable stream crossing.

All three of these factors must be investigated in order to determine if a proposed culvert waterway crossing will or will not materially obstruct navigation.

- 3. A permit may be granted provided the structure does not "reduce the effective flood flow capacity of a stream..."

When this standard was inserted in the statute, the Public Service Commission's intent was to provide an additional tangible standard to evaluate proposed structures. In subsequent decisions this standard was applied at the discretion of the investigator and was not necessarily established by hydraulic calculation. Currently (10-82), we are attempting to develop a program guidance on what constitutes a reduction in the effective flood flow capacity of a stream.

- 4. A permit may be granted provided the structure "is not detrimental to the public interest."

The legislature has authorized the placement of structures in navigable waters for private use provided the statutory standards are met. Many factors, including the following must be considered in order to determine if a culvert is detrimental to the public interest:

- a. Natural scenic beauty.
- b. Potential for interruption of fish or game migration.
- c. Adequacy of design including potential for washout (road embankment stability).
- d. Environmental effects including potential for excessive erosion and its effects on habitat (spawning areas, etc.).
- e. Lack of viable alternatives.

It should be noted that this standard does not require a culvert waterway crossing to be positively in the public interest. The question to resolve when considering a structure application is not "will any adverse effects result" but rather "will any adverse effects resulting from the structure be detrimental to the public interest." A balancing of public and private rights is required to make this determination.

### ***Administrative Code Standards***

- 1. Wetlands. NR 1.95, Wis. Adm. Code, establishes general standards to be applied by the Department in decisions affecting wetlands. The Department shall consider proposals which require its approval with the presumption that wetlands are not to be adversely impacted or destroyed and that the least overall adverse environmental impact shall result.

2. Shoreland Zoning. NR 115, Wis. Adm. Code, establishes administrative standards which must be followed by counties in their administration of shoreland zoning ordinances. These standards shall be reflected in approvals issued pursuant to 30.12, Wis. Stats.
3. Floodplain Zoning. NR 116, Wis. Adm. Code, establishes administrative standards which must be followed by local units of government. Permits issued under 30.12, Wis. Stats., should require applicants to conform with these standards.
4. Regulation of Bridges and Culverts. NR 320, Wis. Adm. Code, establishes uniform navigation clearance and flood flow standards for bridges, arches or culverts in or over navigable waters. New bridges, arches or culverts must generally provide navigational clearance of 5 feet. More or less clearance may be required or allowed according to the provisions in NR 320.04. Flood flow requirements for culverts are basically those found in NR 116. Plan and informational requirements for permit applications are found in NR 320.06.
5. Environmental Impact. NR 150, Wis. Adm. Code, establishes procedures for determining whether a given project requires an environmental impact statement (EIS). Culverts are Type II actions which do not normally require an environmental assessment.
6. Municipal Highway Bridges. Trans 207, Wis. Adm. Code, establishes design and construction requirements for municipal highway bridges, arches and culverts and a Department review procedure to be initiated by municipalities. This procedure applies to projects where there is no Department of Transportation involvement.

### ***Administrative Interpretations***

1. Railroad Bridges. Bureau of Legal Services opinions (1-5-73, 1-18-79 and 7-25-79). Railroad corporations are not exempt from bridge or structure permit requirements. According to s. 190.08, Wis. Stats., upon abandonment of a railroad, watercourses must be restored to their former state or to such conditions that their usefulness is not materially impaired. Railroad corporations are required to apply for structure permits for culvert placement or replacement.
2. County Forest Road Crossing. Bureau of Water Regulation and Zoning (WR&Z) program guidance (2-10-82). If the forest road is a public highway, Trans 207, Wis. Adm. Code procedures should be followed.
3. Department responsibilities under Trans 207, Wis. Adm. Code. Division Administrator program guidance (9-11-80). This is an eight page guidance and should be referred to directly (see copy attached to Chapter 80 of the Handbook).
4. Program Guidance, Trans 207, Wis. Adm. Code. Bureau of WRZ guidance (3-16-82). This is a 4 page guidance and should be referred to directly (see copy attached to Chapter 80 of the Handbook).

## **PROCESS**

### ***Application***

Application review includes examination of the application form, plans, the field investigation and hydraulic analysis. Applications with insufficient information to complete any aspect of the review should be returned to the applicant with whatever instructions are necessary to secure needed information.

Plan requirements: In order to properly evaluate a culvert crossing it is necessary to have accurate design and topographic data. For new culvert waterway crossings a hydraulic analysis is required to determine: whether flood plain standards are met; various flood elevations to assist in establishing whether the culvert and fill reduces the effective flood flow capacity of the stream; whether the design is sufficient to prevent excessive streambed erosion; and whether the road embankment is adequate to prevent or minimize the chance of washing out. Plans required to complete application review include:

- a. Location map of sufficient detail to allow field staff to properly locate the project area.
- b. Plan view (to scale) of project site showing:
  1. Property lines
  2. Location of waterway
  3. Existing buildings, roads or bridges
  4. Location of proposed culvert and roadway
- c. Detailed plans of culvert and road fill
  1. Cross-section perpendicular to culvert and parallel to fill showing:
    - a. Flood plain cross section. This is required to conduct a hydraulic analysis for a culvert waterway crossing. The cross section must extend to an elevation above the regional flood plain. If the flood plain is relatively uniform in configuration near the project site, one cross section should be sufficient. However, if a natural or man-made constriction exists in the vicinity of the proposed culvert, either upstream or downstream, it (they) would effect stream hydraulics. Cross sections at any constrictions should be provided so that hydraulic analysis can account for their effects.
    - b. Proposed road elevations, culvert size and placement
    - c. Normal water level and high watermark (if known)
  2. Cross-section parallel to culvert and perpendicular to fill showing:
    - a. Bed of waterway
    - b. Elevations of the upstream and downstream culvert invert
    - c. Embankment slopes and road elevation
    - d. Type of culvert inlet (projecting, mitered or headwall)
    - e. Length of culvert
- d. Other information necessary to complete hydraulic review include:
  1. Stream slope. Elevation of water surface 1000 feet upstream and 1000 feet downstream as well as at any intervening changes in water surface profile.

2. Photographs of flood plain cross section(s). Photographs are necessary to accurately estimate channel and overbank roughness factors.

NOTE: It is highly desirable that stream slopes and flood plain cross section(s) be surveyed by an engineer, surveyor or government technician in order to accurately analyze a project.

Evaluation of replacement culverts will not require hydraulic analysis if the replacement roadgrade and culvert has water passing capability at least as large as the existing road grade and culvert. Note that this provision applies to culvert waterway crossings that are Legally authorized or "presumed in conformity with the law". Replacement of unauthorized culvert waterway crossings which were initially constructed after we began to apply permit requirements should be evaluated as a new structure and would be subject to the regular flood flow requirement of Chapter NR 116, Wis. Adm. Code.

### ***Notice Requirements***

A public notice is required for culvert waterway crossing permit applications. An exception to this requirement might be when department personnel are clearly in opposition, due to nonconformance with statutory standards, in which case a notice of public hearing could be issued since s. 31.06, Wis. Stats., allows this option. In some cases where it is recognized that a hearing will be required it may still be desirable to issue a notice of proposal to solicit public opinion, particularly when the project is suspected to be highly controversial.

### ***Design Considerations***

The following section on design considerations is presented to give the project evaluator some basic information on the performance of culvert waterway crossings. Some of the information can be used to make suggestions to permit applicants. The information can also be used when inspecting a completed project as a "check list" to verify that the project was properly constructed.

- A. Location: On streams, culverts should be located in such a manner that the least amount of channel obstruction and road embankment fill are required. If, during field investigation, it appears that shifting a proposed culvert a short distance upstream or downstream would lessen the obstruction to flood flows or that modifying the bank (excavating an approach) would minimize fill, make the appropriate recommendation to the applicant or make such requirement a permit condition.
- B. Size:
  1. Normal Stream Flow: On a stream, a culvert should be large enough to pass normal stream flow without creating any backwater. There are several reasons for this recommendation. Normally there will be little increase in velocity through the culvert so fish migration should not be hindered. A culvert waterway crossing meeting this recommendation would probably be able to handle flood flows without causing excessive backwater elevations. If one culvert has insufficient capacity, two or more culverts might be suggested. If, in addition, the stream channel is too narrow to accommodate more than one culvert, consider enlarging the waterway as required to allow the installation. Appropriate s. 30.19 provisions could be incorporated in the structure permit.
  2. Navigational Clearance: The criteria of NR 320 should be followed. A recommendation to increase culvert size for navigation on a stream which has little or no history of navigation may not be necessary. There is no requirement that every stream crossing must provide navigational clearance. In those instances where a stream receives minimal canoeing, for example, requiring

the applicant to provide a portage might be a better solution. Embankment fill could be minimized and perhaps the statutory standards would be met to a greater degree.

C. Installation:

1. On streams it is advisable to suggest or require culverts to be installed with the bottom (invert) of the culvert below the bed of the stream. Depending on the size of the culvert, the invert should be installed 3" to 12" or more below streambed. Installation in this manner may have the following benefits:
  - a. Flow capacity may be increased since the head on the upstream side will be increased in relation to the culvert invert.
  - b. Less fill may be required over the culvert creating less obstruction to flood flow (easier to be overtopped).
  - c. Fish migration and perhaps spawning will be impaired to a lesser degree. During high flows material will probably scour out of a culvert, but as flow diminishes any bed material carried by the stream will tend to settle out in the culvert. During low flows the corrugated bottom of metal culverts might be nearly impossible for fish to swim over but if, for example, sand has settled in the bottom, a narrow channel cut by the flowing water might be deep enough to allow fish migration.
2. Culvert slope can be an important factor insofar as culvert capacity is concerned. A culvert operates either under inlet control or outlet control. For inlet control the pipe size, shape and entrance type (geometry) are the principal factors controlling culvert capacity. For outlet control, culvert capacity is dependent upon pipe length, slope, entrance type (geometry), roughness, size, shape, and tailwater depth. As you can see, if for no other reason than the number of capacity controlling factors, inlet control is more efficient with equal headwater elevations. The operation of a culvert can sometimes be changed from outlet control to inlet control by increasing pipe slope, although for most stream crossings this could be difficult to do. As an example of how pipe slope and roughness relate under outlet control, a corrugated metal pipe with free flow would have to be placed at a slope 4 times steeper than the same size concrete pipe to have the same capacity since the metal pipe has a roughness coefficient 2 times larger than concrete pipe.

D. Culvert Inlet Types: Culverts can be installed with various types of inlets. Corrugated metal pipes may be installed projecting from embankment fill, with a mitered (beveled) end, with a prefabricated steel end section, with a square edge concrete headwall or a rounded edge concrete headwall. Generally, factors which are considered in determining inlet type are:

1. Economy (reduced pipe lengths may offset the use of a particular inlet type)
2. Embankment slope and stability (headwalls could retain fill slope)
3. Hydraulic efficiency

Hydraulic capacity is affected considerably by inlet type. The head or backwater is determined in part by the entrance type and velocity of flow in the culvert. For example, consider a full flowing culvert with a velocity of 10 feet per second. The portion of total head caused by inlet type would be as follows:

Inlet Type	Entrance Loss Coefficient	Increased Head (in feet)
Projecting	0.9	1.4
Mitered	0.7	1.1
Steel end section	0.5	0.8
Square edge concrete headwall	0.5	0.8
Rounded edge concrete headwall	0.2	0.3

- E. **Pipe Shape:** Circular culverts and pipe arch culverts are commonly used for waterway crossings. Insofar as hydraulic performance is concerned, pipe arch shapes are superior to circular shapes of equal circumference during low flow conditions. The effective flow area of an arch pipe is approximately 45% greater than the effective flow area of an equivalent circular pipe at a depth of flow equal to one-half the diameter of the circular pipe. Greater effective flow area results in a lower outlet velocity and a reduced backwater effect. A lower outlet velocity means less erosion potential downstream. A reduced backwater effect means reduced flood damage potential upstream and less chance that a roadway will be overtopped. In addition, use of an equivalent pipe arch will mean less fill is required for the road embankment. Cost-wise, there is little difference in price between equivalent circular culverts and pipe arch culverts. To illustrate the advantage of pipe arch culverts, the following pipe comparison chart has been developed for hypothetical design parameters. Note that generally the calculated backwater and velocity is less for pipe arches.

EQUIVALENT PIPES	NORMAL STREAM FLOW (cubic feet per second)	NATURAL STREAM DEPTH (feet)	UPSTREAM DEPTH WITH CULVERT (feet)	BACK-WATER	CULVERT OUTLET VELOCITY (feet per second)
36" Diameter	50	2.19	5.12	2.93	8.37
43"X27" Arch	50	2.19	5.26	3.07	8.03
48" Diameter	50	2.86	5.21	2.35	8.47
58"X36" Arch	80	2.86	4.94	2.08	7.21
60" Diameter	120	3.48	5.76	2.28	8.48
72"X44" Arch	120	3.48	5.36	1.87	7.13
72" Diameter	150	4.15	6.64	2.49	8.86
81"X59" Arch	180	4.15	6.37	2.21	7.46

It is quite apparent from review of the above-chart that pipe arch culverts hydraulically out perform equivalent circular culverts in most low flow situations. Whenever possible, therefore, field staff should recommend the use of pipe arch culverts in lieu of circular culverts. Although a single culvert was used for illustration, you will note that multiple culverts would be needed to reduce backwater.

- F. **Culvert Outlet Problems:** When a given amount of water flowing in a stream is forced to go through a constriction such as a culvert the velocity continuity equation  $Q=VA$  generally applies to this situation. Since  $Q$  (amount of flow) remains the same and  $A$  (area of flow) is reduced,  $V$  (velocity of flow) must increase. The amount of velocity increase is proportional to the ratio of the unrestricted area of flow in the stream to the area of flow in the culvert. It is not unusual for velocity of a culvert to be 3 or 4 times higher than the natural stream channel. Such an increase in velocity could make it nearly impossible for fish to migrate. The effects of high velocity culvert

outlet flow can also be very damaging, both to the stream and to the road embankment. The concentrated flow is highly erosive to the streambed. A scour hole may develop at the culvert outlet and any eroded bed material will be transported until it eventually settles out of the water. Downstream sedimentation can be environmentally damaging. The concentrated culvert outlet flow also tends to create eddy currents on either side of the culvert outlet. These eddy currents will cause erosion of stream channel banks and the toe of the road embankment. This additional erosive action may add to the downstream sedimentation problem and could result in road embankment failure.

A very significant factor in contributing to these problems is the use of culverts which are too short. Generally a culvert without headwalls or end sections should be long enough so that the inverts at each end extend at least to the toe of the road fill.

In order to prevent or minimize the highly erosive effect of culvert outlet velocity and accompanying eddy currents, some degree of protection should be provided to the road embankment and streambed. The following methods of protection are commonly used:

1. **Riprap:** The base of the road embankment and streambed may be covered by an adequate layer of riprap. The size of riprap and extent of placement is dependent upon the type of material to be protected and the magnitude of the outlet velocity. Generally, riprap should be at least 6 inches thick but a thickness of up to 3 feet may be required when excessively high erosion potential exists. About 75% of the riprap material (by weight) should be larger than 3 inches in size and well graded. The maximum stone size required to resist erosion varies from about 6 inches for velocities of 5 feet per second to about 36 inches for velocities of 14 feet per second. Depending on the severity of the erosion potential, streambeds should be protected to about 2 feet above expected tailwater elevations. Prior to placement of streambed riprap, native material equal to the depth of the riprap layer should be removed so no additional restriction to stream flow results.
  2. **Prefabricated Steel End Section:** End sections tend to spread the culvert outlet flow laterally across the natural stream channel. This helps to break up concentrated outlet flow. The end section also tends to protect that portion of the embankment which would otherwise be subject to the highest degree of eddy currents. Some riprap may be required on the embankment slope for additional protection depending on the severity of the erosion potential. The end section also has an apron (bottom) which helps to prevent formation of a scour hole at the culvert outlet. Again, some riprap may be required downstream of the end section for additional protection.
  3. **End Walls:** Steep embankment slopes may require an end wall to prevent embankment failure due to eddy currents. This treatment is generally expensive and the necessity for its use could be mitigated by altering embankment slopes and culvert length. Again, riprap or a concrete apron may be required to overcome erosion of the streambed.
- G. **Embankment Material:** The stability of a culvert waterway crossing requires not only adequate design of the culvert but the use of good road embankment material. The ability of the culvert to retain its shape and structural integrity is highly dependent on the selection, placement and compaction of the embankment material. A metal culvert is a flexible conduit which deflects under load. To prevent excessive deflection or failure the road embankment must provide lateral support to the culvert. Bank run gravel or similar granular material, properly compacted makes an ideal road embankment. Strength is developed by internal friction from the angular shapes interlocking. Granular material is drainable and not subject to undesirable performance when wet. On the other hand, silt and organic soils are totally unsuitable for good road embankments. When wet they tend to be highly compressible and lose structural capacity. They also tend to retain moisture and

therefore remain unstable for long periods of time. Most locally obtained soils are a mixture of coarse grained and fine grained material and with proper placement and compaction should make adequate road embankments.

Embankment fill should be placed in 6 to 8 inch layers and compacted within one pipe diameter on either side of the culvert. Often tire or track pressure from construction equipment together with hand or mechanical tamping within a foot or two of the pipe will provide adequate compaction. Compaction around the culvert pipe is required not only to develop pipe strength but to minimize settlement and potential piping (water seeping along the culvert-removing fine materials) which could lead to embankment failure when subjected to water pressure. Water pressure exists because of the head difference between the upstream and downstream water elevations. Piping or saturation of the road embankment can be minimized by placing a layer of impervious soil (such as clay) on the upstream slope.

- H. Embankment Slope and Protection: Generally an embankment slope steeper than 1-1/2 horizontal to 1 vertical cannot be stabilized with vegetation and will require riprap protection. This is particularly true of the downstream slope of a road subject to overtopping. If this is the case, it may be necessary to riprap the downstream slope to prevent washout, although well vegetated flatter slopes (3:1 or flatter) can withstand some overflow. Whether or not stable vegetation can be established on a road embankment at all is dependent on soil type more than embankment slope. A sand and gravel road embankment with 3:1 slopes is unlikely to develop a good vegetative cover unless topsoil has been placed on the slopes. Soils with a good loam mixture should have slopes of 2:1 or flatter depending on the potential for overtopping. Every stream crossing should have riprap placed at areas subject to erosion such as around the inlet and outlet.

In order to minimize erosion the toe of all embankment slopes should not extend beyond the end of the culvert pipe unless a headwall or end section contains the fill.

## **FIELD INVESTIGATION**

Field investigations are conducted primarily to determine the feasibility of the proposal. The investigation form (3500-23), if properly completed, should allow personnel unfamiliar with the project site to grasp the scope of the proposal fairly well. The investigators should address the following questions:

- a. Do the plans appear to accurately represent the proposed culvert installation
- b. Is there a better alternative site for the culvert installation in the immediate area?
- c. Has the flood plain cross section been taken at a location representative of the area?
- d. Are there natural or man-made constrictions in the vicinity of the proposed culvert which have not been shown or for which cross sections should be supplied?
- e. Should less fill be used for the road embankment to minimize adverse effects on flood flows?
- f. Does the culvert(s) appear to be large enough considering the need to conduct normal stream flow without restriction?
- g. Will the culvert be an obstruction to navigation considering seasonal usage of the stream?
- h. Could any damage occur upstream as a result of flooding caused by the culvert installation?

- i. Will the culvert prevent or hamper fish migration and spawning activities?

## **FINAL DISPOSITION**

The significance of technical review should be considered prior to issuance of a permit. The hydraulic analysis of a culvert crossing should not be regarded as a separate function solely to determine compliance with flood plain management standards. As mentioned previously, the results of hydraulic analysis must be considered in order to determine if a proposal meets statutory standards. Technical review determines natural flood stages at various flows, backwater effects at various flows, and culvert outlet velocities at various flows. This information can be used to determine:

- a. If a culvert reduces the effect flood flow capacity of a stream.
- b. If environmental damage may result from the culvert installation by:
  1. Scouring of streambed below culvert and subsequent downstream deposition.
  2. Deposition of material upstream of culvert due to reduction in stream velocity and/or impoundment.
  3. Erosion of road embankment due to unstable embankment slopes, overtopping or eddying of flow at culvert outlet.

Since the technical review could have a significant bearing on the results of the field investigation, every effort should be made to have it completed prior to the field check.

When the hydraulic review and field investigation have been completed we are in a position to determine if the permit application meets statutory standards. If it does meet standards the permit may be issued. If it does not meet standards, it will be necessary to request a hearing. A permit can only be denied by a decision of a hearing examiner.

Any person objecting to the decision issuing or denying a permit may seek judicial review by serving and filing a petition in accordance with the provisions of sections 227.15 and 227.16, Wis. Stats., within thirty (30) days of the decision date.

## **MONITORING**

Permits should require the applicant to notify the Department five days before starting work and within five days of the completion of work. There should be a follow-up inspection to determine whether the work was done in accordance with the permit. Enforcement action should be considered if the work deviates significantly from the plans.

## **EMERGENCY PROCEDURES**

On occasion existing culvert waterway crossings may sustain damage or fail due to flooding or accidents. If the culvert is authorized or "presumed in conformity with the law" we should allow repair or reconstruction without invoking permit requirements. Generally if a culvert needs to be replaced we should require the replacement to be of at least equal capacity.

## **ENFORCEMENT**

Section 30.12(3), Wis. Stats., provides for a fine of not more than \$1,000 or imprisonment for not more than 6 months or both for violation of s. 30.12 provisions OR for violating any term or condition of a permit issued under s. 30.12.

Section 30.15, Wis. Stats., provides for a forfeiture of up to \$50 a day for any structure in violation of s. 30.12. It also declares an obstruction to be a public nuisance and provides for abatement at a suit of the state or any citizen.

## **EDUCATIONAL MATERIALS**

Pamphlet, "Wisconsin's Water Regulation Programs Work for You"

Pamphlet, "Saving Your Shoreline"

**CORRESPONDENCE/ MEMORANDUM****STATE OF WISCONSIN**

DATE: June 26, 1984

3550 (WMC)

TO: District Directors

PMMS Response

Put in: Chapter 12 Floodplain Shoreland Guidebook and  
Ch. 85, Water Regulation Handbook

FROM: Robert Roden

Distribution: All Program Staff

SUBJECT: Simplified Method for Approximating Increase in Flood Stage Resulting from Culvert Crossings  
of Small Streams

The following procedure may be used by district and area staff in estimating the increase in flood stage which may be caused by a stream crossing for small streams. Its use is limited to streams which have no detailed study available.

1. Determine the total height of fill (y) associated with the stream crossing. (This is the elevation in feet from the bottom of the stream bed to the top of the fill over the culvert.)
2. Determine the slope(s) of the stream which will be crossed using USGS Quad sheets. Identify a contour line downstream from the project site and measure the distance along the stream to another contour which crosses the stream above the project site. Divide the difference in elevation represented by the contour lines by the distance between them along the stream-in feet to determine the slope in ft./ft.
3. Determine the upstream limit of potential increase in flood elevation by dividing the total fill elevation (y) by the stream slope (s) and measuring the resultant distance on the Quad map.
4. Legal Arrangements, Amendments and Notification
  - a. Area Not Zoned

The project may be approved for construction upon verification that all property owners within the upstream limit of potential increase have agreed to appropriate legal arrangements, either by flowage easements or by signing a waiver indicating they are not concerned with the increase in flood stages resulting from the proposed projects.

The district office shall provide a copy of the data showing the calculated flood levels to the Bureau and the community.

If the entire increase will be contained on the applicant's property, there is no need to obtain either

flowage easements or waivers.

b. Area Regulated by FP Zoning Ordinance

The community must amend its ordinance by adopting the profile generated by the approximation after appropriate legal arrangements are made with all affected property owners.

This procedure may be used for municipalities constructing culvert crossings under Trans. 207.

Reviewed by:

P. Scott Hausmann                      Date: 6-24-84

Larry A. Larson                          Date: 6-24-84

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